MECHANICAL PROPERTY DATA
INCONEL 625

Annealed Sheet

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Air Force Materials Laboratory
Air Force Systems Command
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Prepared by

Battelle Memorial Institute
Columbus Laboratories
Columbus, Ohio 43201

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This data sheet was prepared by Battelle Memorial Institute under Contract F33615-70-C-1070. The contract was initiated under Project No. 7381, "Materials Applications", Task No. 738106, "Engineering and Design Data". The major objectives of this program are to evaluate newly developed structural materials of potential Air Force weapons-system interest and then to provide data-sheet-type presentations of these data. The program was assigned to the Structural Materials Engineering Division at Battelle under the supervision of Mr. Harold Mindlin. Project engineer was Mr. Omar Deel. The program was administered under the direction of the Air Force Materials Laboratory, Air Force Systems Command, Wright-Patterson Air Force Base, Ohio, by Mr. Clayton Harmsworth, Technical Manager, Engineering and Design Data.

Notices

Iconel 625 Alloy

Iconel 625 is a relatively new product of Huntington Alloy Products Division of The International Nickel Company, Inc. It is reported to have high strength and toughness from cryogenic temperatures to 2000 F. It is a nonmagnetic alloy deriving its strength from the stiffening effect of molybdenum and columbium on its nickel-chromium matrix. It has good oxidation resistance and is virtually immune to chloride-ion stress-corrosion cracking.

Inconel 625 is readily fabricated by common industrial practices and has excellent weld qualities, requiring no postweld thermal treatment for maintenance of its corrosion resistance. The alloy has already been used in numerous aerospace applications and is currently being evaluated for use in the chemical and marine fields.

Standard mill forms including sheet, strip, rods and bars, shapes, tube and plate are available.

The nominal composition of Inconel 625 is as follows.

C	Mn	Fe	S	Si	Cr	Al	Ti
0.10	0.50	5.0	0.015	0.50	20.0-23.0	0.40	0.40

Mo	Co	P	Cb + Ta	Ni
8.0-10.0	1.0 max	0.015	3.5-4.15	Balance

Inconel 625 Data[a]

Condition: Annealed
Thickness: 0.125-inch sheet

Properties	Temperature, F			
	RT	800	1200	1600
Tension				
TUS (longitudinal), ksi	138.7	123.3	112.3	29.8
TUS (transverse), ksi	136.7	122.3	113.0	29.3
TYS (longitudinal), ksi	69.5	53.3	48.9	29.7
TYS (transverse), ksi	69.6	53.6	49.6	29.0
e_t (longitudinal), percent in 2 in.	51.1	50.0	97.0	123.0
e_t (transverse), percent in 2 in.	50.0	51.0	81.3	118.0
E_t (longitudinal), 10^6 psi	28.3	24.1	22.5	14.6
E_t (transverse), 10^6 psi	30.3	25.0	24.7	18.1
Compression				
CYS (longitudinal), ksi	71.5	57.5	55.6	31.5
CYS (transverse), ksi	73.4	59.0	54.9	31.4
E_c (longitudinal), 10^6 psi	29.1	24.0	24.8	15.5
E_c (transverse), 10^6 psi	30.7	26.2	25.2	14.2
Shear[b]				
SUS (longitudinal), ksi	114.5	U[e]	U	U
SUS (transverse), ksi	115.8	U	U	U
Bend[c]				
Longitudinal, minimum radius	T/5	U	U	U
Transverse, minimum radius	T/5	U	U	U
Fracture Toughness, K_c[d]				
ksi$\sqrt{\text{in.}}$	(d)	U	U	U
Axial Fatigue (transverse)[f]				
Unnotched, R = 0				
10^3_5 cycles, ksi	140	120	100	U
10^7 cycles, ksi	106	102	78	U
10^7 cycles, ksi	72	96	68	U
Notched, K_t = 3.0, R = 0.1				
10^3_5 cycles, ksi	130	114	80	U
10^7 cycles, ksi	60	52	48	U
10^7 cycles, ksi	40	40	40	U
Creep (transverse)				
0.2% plastic deformation, 100 hr	NA	(h)	58	1.4
0.2% plastic deformation, 1000 hr	NA	(h)	50	0.8

Properties	Temperature, F RT	800	1200	1600
Stress Rupture (transverse)				
Rupture, 100 hr	NA	>120	72	59
Rupture, 1000 hr	NA	>120	7	3.5
Stress Corrosion				
80% TYS, 1000-hr maximum	No cracks(g)			
Coefficient of Thermal Expansion				
7.4×10^{-6} in./in./F (70 to 500 F)				
8.7×10^{-6} in./in./F (70 to 1500 F)				
Density				
0.305 lb/in.^{3}				

(a) Values are average of triplicate tests conducted at Battelle under the subject contract unless otherwise indicated. Fatigue, creep, and stress-rupture values are from curves generated using the results of a greater number of tests.

(b) Single-shear sheet-type specimen.

(c) Specimens tested at RT, +32 F, and -90 F. No cracks at either temperature.

(d) Specimens were full sheet thickness x 18 in. x 48 in. with EDM flaw in center. Average K_c was 158 ksi$\sqrt{\text{in.}}$ The net section yield stress at fracture was greater than the tensile yield strength of the material; therefore, the K values are considered not valid.

(e) U, unavailable; NA, not applicable.

(f) "R" represents the algebraic ratio of minimum stress to maximum stress in one cycle; that is, $R = S_{min}/S_{max}$. "K_t" represents the Neuber-Peterson theoretical stress concentration factor.

(g) Room-temperature three-point bend test. Alternate immersion in 3-1/2% NaCl.

(h) Extensometer inoperative due to large initial strain; negative creep occurred.

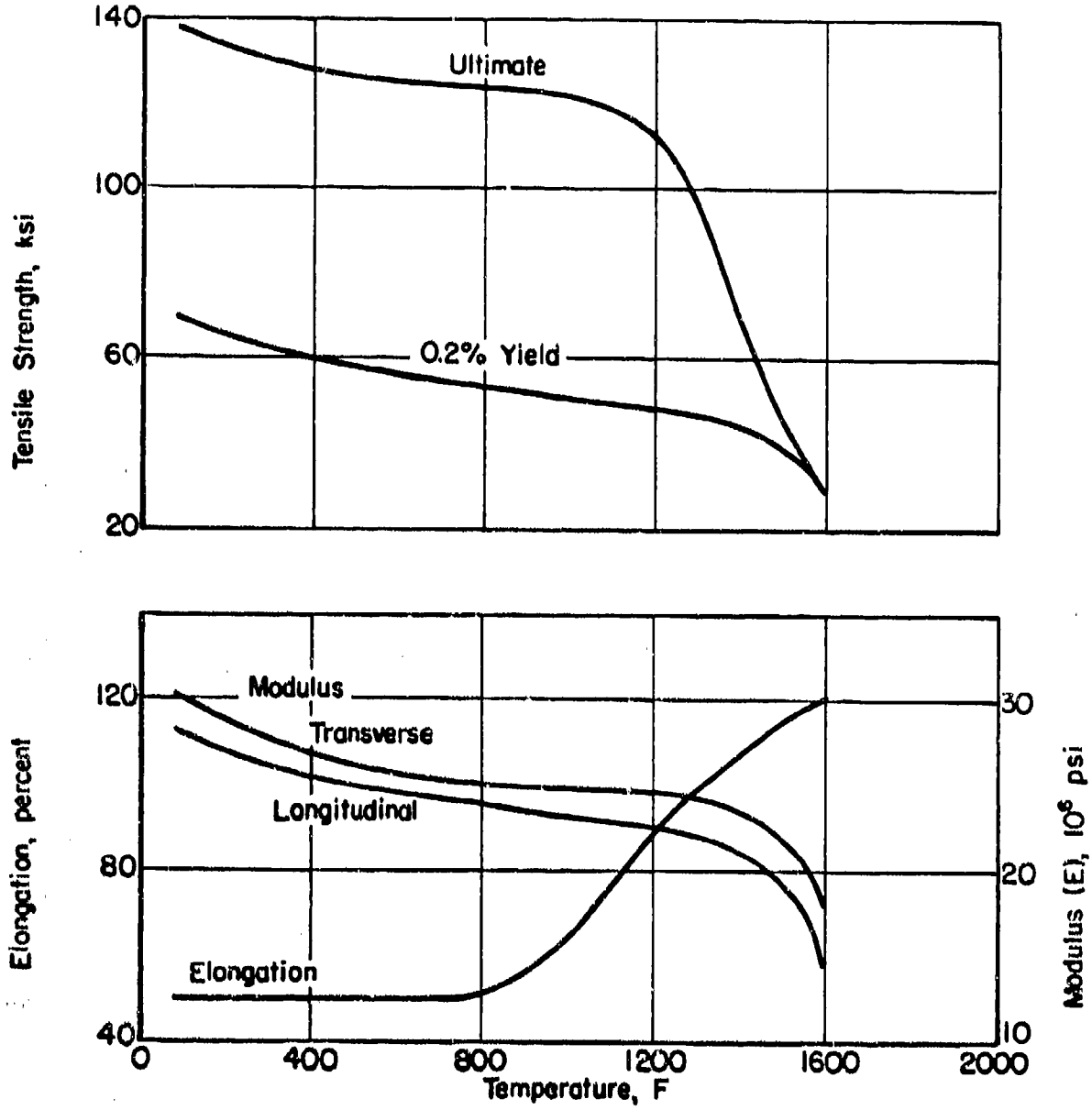

FIGURE 1. EFFECT OF TEMPERATURE ON THE TENSILE PROPERTIES OF INCONEL 625 SHEET

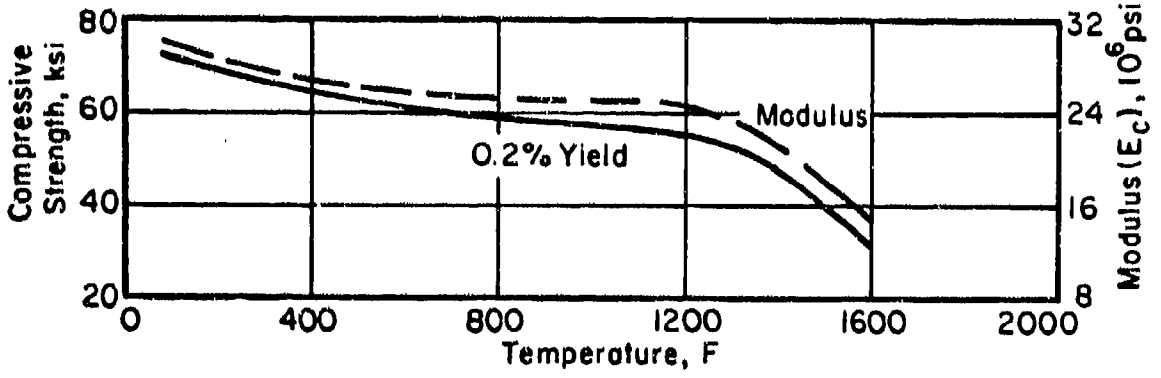

FIGURE 2. EFFECT OF TEMPERATURE ON THE COMPRESSIVE PROPERTIES OF INCONEL 625 SHEET

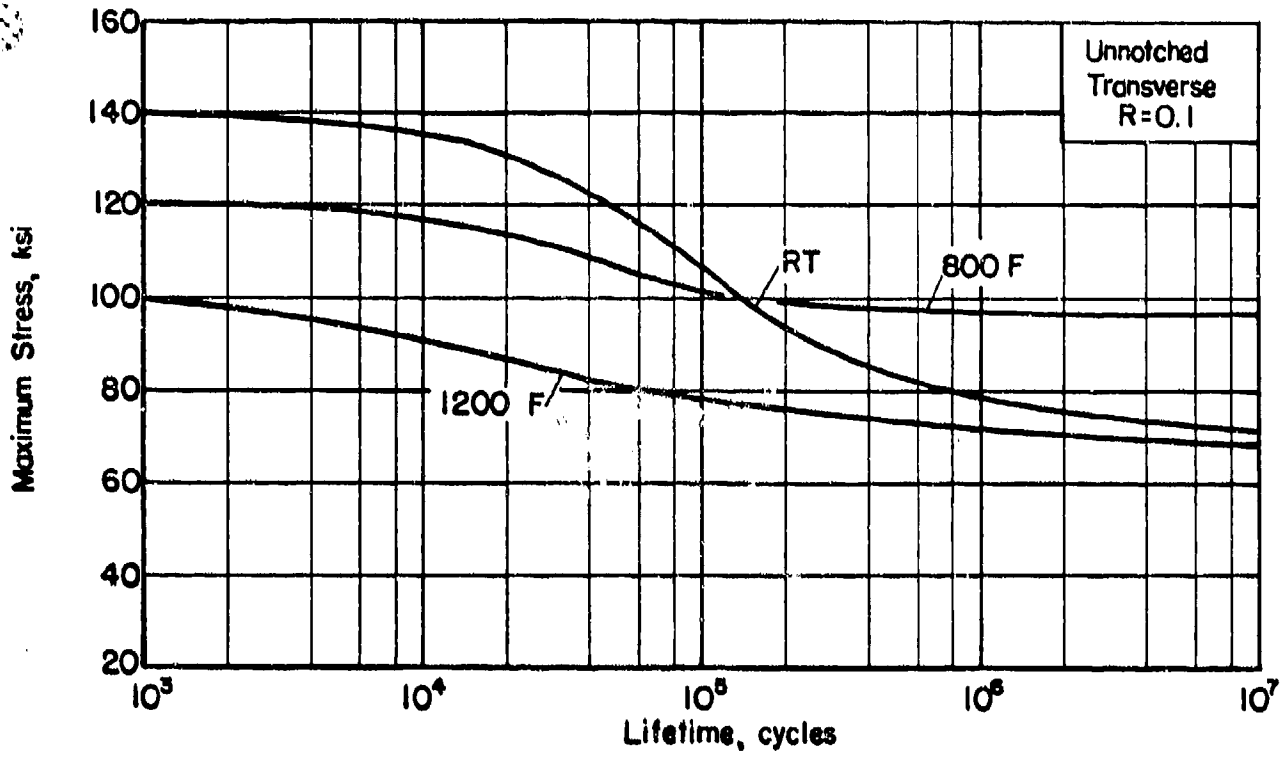

FIGURE 3. AXIAL-LOAD FATIGUE RESULTS FOR INCONEL 625 SHEET

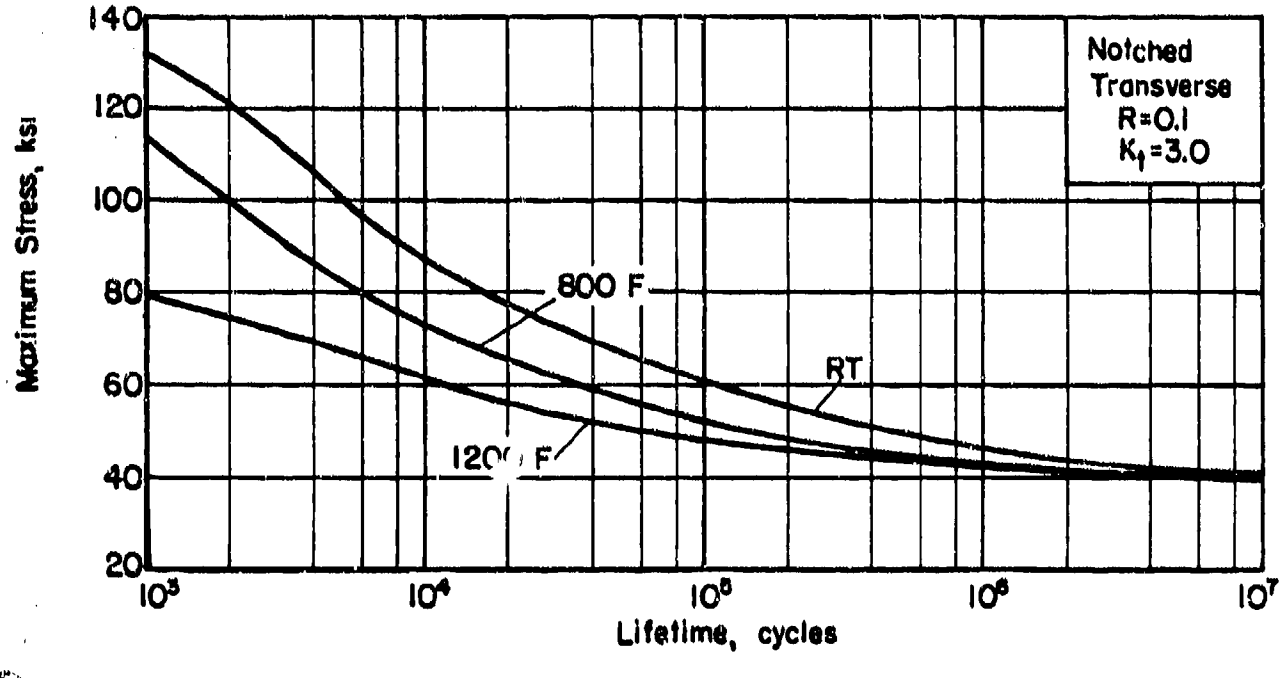

FIGURE 4. AXIAL-LOAD FATIGUE RESULTS FOR NOTCHED (K_t=3.0) INCONEL 625 SHEET

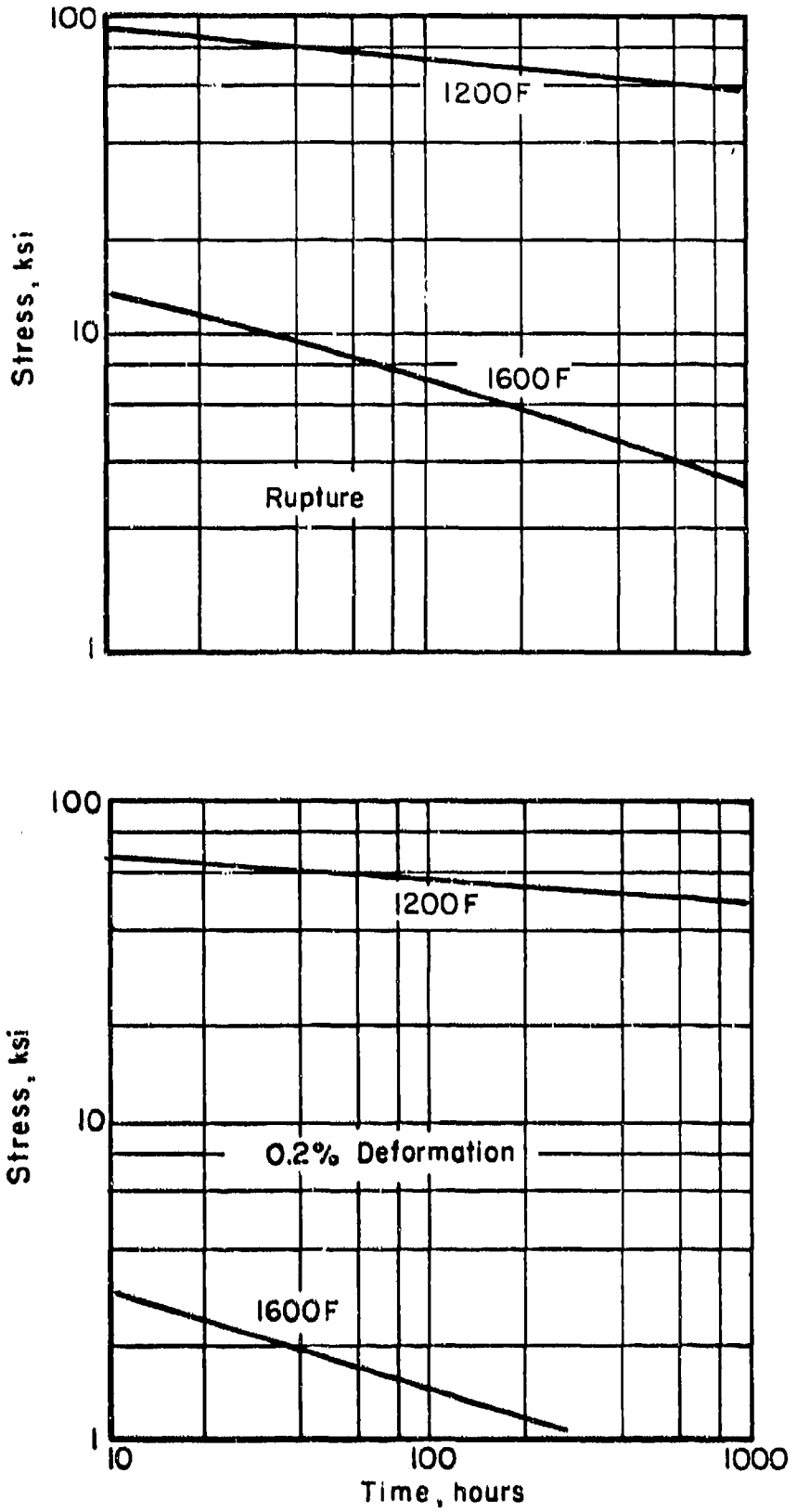

FIGURE 5. STRESS-RUPTURE AND PLASTIC DEFORMATION CURVES FOR INCONEL 625 SHEET